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***Inflation and income inequality: A link through the job-search
process***

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Inflation and Income Inequality: A Link Through the Job-Search Process*

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Abstract

In this paper I devise a new channel by means of which the (empirically documented) positive correlation between inflation and income inequality can be understood. Available empirical evidence reveals that inflation increases wage dispersion. For this reason, the higher the inflation rate, the higher turns out to be the benefit, for a worker, of making additional draws from the distribution of wages, before deciding whether to accept or reject a job offer. Assuming that some workers have less access to information (wage offers) than others, I show that the Gini coefficient of income distribution turns out to be an increasing function of the wage dispersion and, consequently, of the rate of inflation. Two examples are provided to illustrate the mechanism.

1 Introduction

Several works in the economic literature link inflation to income inequality from an empirical perspective. Bulir (1998), Romer and Romer (1998)) and Cardoso et alli (1995) are examples of this type.

Despite the fact that such distributional effects are an important issue in public policy, though, the theoretical literature on the subject is surprisingly

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scarce. In particular, this literature still lacks new ideas and theoretical arguments illustrating how correlations between inflation and inequality can be generated, in the long run, under dynamic settings in which individual consumers maximize the discounted value of their utilities.

Analyses of the link between inflation and inequality usually explore, descriptively, how relationships between capitalists and workers, or between debtors and creditors, are affected by inflation. The usual explanation that poor consumers have less access to interest-bearing money and thereby end up paying a larger share of their income as inflation tax can be included under the debtor/creditor classification as well. A different argument, linking inflation and income distribution thorough the sharing of the welfare costs of inflation, rather than through distributional effects, has been provided by Cysne, Monteiro and Maldonado (2004).

In this paper I devise a new channel by means of which inflation can provoke income inequality¹. The main idea is that consumers with more information can benefit relatively more, in the job-search process, from the increase of wage dispersion, than consumers with less information. Given the stylized fact that wage dispersion is an increasing function of the rate of inflation², the Gini coefficient of income inequality turns out to increase when inflation increases. Two examples are offered to illustrate the proposed mechanism.

The basic model used for the argument draws on Stokey and Lucas's (1989) version of McCall's (1970) job-search model. The paper proceeds as follows. Section 2 presents the basic model and assumptions. Subsection 2.1 formalizes the unconstrained consumer problem, in which the number of draws is a choice variable, depending upon an idiosyncratic cost. Subsection 2.2 simplifies the analysis by assuming a cost function that makes the first

¹More rigorously, this paper deals with long-run wage inequality. However, transfers and capital income usually represent only a small fraction of most households' total income. For the United States, for instance, following the 1992 SCF (Survey of Consumer Finances), transfers and capital income account in average for only around 28% of the total income of the households surveyed. This percentage tends to be even lower in developing countries.

²Wage dispersion is particularly high when inflation reaches a certain level and leads to staggered (lagged) indexation. Under a (mandatory) fixed frequency of adjustments, the ratio of nominal wages of a certain category, just after and before the adjustment, is given by $1 + \pi$, π standing for the rate of inflation. By these means, under staggered indexation, the higher the rate of inflation, the higher the ratio of existing wages. Brazil in the seventies and early eighties is an example of an economy facing such circumstances. Simonsen (1970) and Dornbusch and Simonsen (1986) are usual sources on this issue. Cardoso (1993), Cardoso et alli (1995) and Souza (2003) present more recent empirical evidence that high rates of inflation increase wage dispersion.

draw free for all workers, whereas other draws are free for a subgroup of workers, and prohibitively expensive for the remaining workers.

Under this constrained setting, which is going to be the one used to deliver the main result of the paper, I solve for the reservation wage and (in subsection 2.3) for the long-run average wage of each of the two groups of workers. The long-run average wage is calculated under the invariant distribution of the Markov process determined by the constrained optimization problem. Subsection 2.4 is used to show how to calculate the Gini coefficient of income distribution under a given level of inflation and wage dispersion. The main result of the paper, as well as two examples, are delivered in section 3. Section 4 concludes.

2 The Model

I start by formalizing the unconstrained problem faced by the worker, when he is allowed to choose the number of offers he can draw from the distribution of wages. The givens of the model are the distribution of wage offers faced by the workers, the distribution of technology/cost of acquiring additional job offers and the probability that a certain worker faces, each period, of losing his job.

In the measurable space $([0, 1), \mathcal{B}_{[0,1)}, \mathcal{L})$, $\mathcal{B}_{[0,1)}$ standing for the Borelians in $[0, 1)$ and \mathcal{L} for the Lebesgue measure in this space, consider a continuum of workers. Each worker has certain technology/cost to get draws from the exogenous distribution of wages. Other than that, workers are all equal. Such a technology leads to a cost, for worker j , $j \in [0, 1)$, of acquiring n draws from the distribution of wages, given by $k_j(n)$.

For $0 < D < \infty$, consider the second measurable space (Ω, \mathcal{F}, p) and, in this space, the measure q induced by the (real) wage function $w: \Omega \rightarrow [0, D]$. In the space induced by w , $([0, D], \mathcal{B}_{[0,D]}, q)$, denote by $F(t)$ the distribution function that (q -a.e. -uniquely) determines the measure $q: F(t) = p(w \leq t)$.

In the remaining, subindex j is only introduced when strictly necessary. The consumer is not allowed to borrow or to lend. His consumption c_t is equal to his income w_t in each period. The consumer maximizes:

$$E \left(\sum_{t=0}^{\infty} b^t c_t, \quad 0 < b < 1 \right)$$

2.1 The Unconstrained Optimization

Once the consumer chooses n , he only considers, in the beginning of the next period, the best (maximum) offer w among the n offers. At this point, the consumer can accept or turn down the best offer. If he accepts, he stays employed one period for sure. At the end of this period either he is laid off, with probability θ , or he keeps his job and wage for sure for one more period, with probability $1 - \theta$. The worker is never allowed to voluntarily quit his job or to search while working. If he does not accept the offer or if he is laid off, he restarts the problem by choosing another number of offers n for the next period. The job offers are drawn independently from $[0, D]$ according to the measure q . q is known by all workers.

The formal analysis of the unconstrained problem starts backwards, by assuming that the consumer has already decided about n . The decision at this point, to which I turn now, is resolving about accepting or rejecting the best offer at hand. The states of the problem are given by the wage offers at hand, as well as by the status E (employed) and U (unemployed).

When already employed with wage w , the value function of any consumer is:

$$v(w, E) = w + (1 - \theta)bv(w, E) + \theta bV \quad (1)$$

where V is the optimum present value for the consumer when he follows the whole course of choosing the optimal strategy, starting with the choice of n .

If unemployed, but with a (best) wage offer w at hand (A for accept, R for Reject):

$$v(w, U) = \max_{A, R} \{w + (1 - \theta)bv(w, E) + \theta bV - k(n), bV - k(n)\} \quad (2)$$

Solving for $v(w, E)$ in (1) and using (2) :

$$v(w, U) = \max_{A, R} \left\{ \frac{w + \theta bV}{1 - b(1 - \theta)} - k(n), bV - k(n) \right\} \quad (3)$$

Since the optimization above is carried out under a fixed value of n , and since b and θ are given parameters, the above equation implies that the optimum strategy is of a reservation-wage type. The reservation wage \bar{w} can then be expressed as a function of V by the equalization of the two terms in the second member of (3):

$$\bar{w} = bV(1 - b(1 - \theta) - \theta) \quad (4)$$

Since V is the value function when n assumes its optimal value, \bar{w} is not a function of n and the value function (3) can be determined by:

$$v(w, U) = \left\{ \begin{array}{ll} bV - k(n) \quad (= \frac{\bar{w} + \theta bV}{1 - b(1 - \theta)} - k(n)) & \text{if } w < \bar{w} \\ \frac{w + \theta bV}{1 - b(1 - \theta)} - k(n) & \text{if } w \geq \bar{w} \end{array} \right\} \quad (5)$$

Make $F_{(r,n)}$ stand for the distribution function of the order statistics of order r , of a sample of size n , and $E_{(n,n)}$ for the respective expectation operator. Define:

$$G(n) = E_{(n,n)}v = \int_0^D v(w, U) dF_{(n,n)}(w)$$

The unconstrained consumer problem reads:

$$V = \max_n G(n)$$

Note in the equation above that the optimum n is equal to plus infinity when $k(n) = 0$. Indeed, since the consumer makes his decision based on the highest offer, the higher the number of offers he gets the better, because all additional information can be simply disregarded.

2.2 The Constrained Optimization

From now on I want to incorporate into the model, in the easiest possible way, a usual real-world situation in which some consumers end up with more wage offers than others, irrespective of their efforts to change it.

The most direct way of capturing this occurrence, without introducing unnecessary calculations that would not add to the main point of the paper, is by postulating that the cost of the first draw is zero for all consumers, and that the cost of any quantity of additional draws is zero for a first group of consumers (say, all j in $[0, \bar{j})$) and infinite for the remaining consumers (all j in $[\bar{j}, 1]$). From the analysis of the precedent subsection, assuming this technology is equivalent to assuming that consumers in cohorts 0 to \bar{j} will always end up with one job offer, and consumers in cohorts from \bar{j} to 1 will have a number of offers tending to infinity.

From this point on, I will denominate workers in $[0, \bar{j})$ by “group P ” (P for poor) and workers in $[\bar{j}, 1]$ by group R (R for rich).

Given the above construction, it is an easy guess that consumers in group R will be better off than consumers in group P . The formal point I want to make, though, does not concern the level of the ratio between the wages in group R and group P . It concerns the variation of this level with the rate of inflation.

The constrained problem solved by the consumer under the cost function postulated above is of a simpler nature. He only has to decide whether to accept or reject the best wage offer at hand, given the number of draws from the distribution allowed by nature. There is no previous decision about n . The constrained value function of consumers making n draws from the distribution of wages, when a best offer w is at hand is:

$$v(w) = \max_{A,R} \left\{ w + (1 - \theta)bv(w) + \theta b \int_{[0,D]} v(w') dF_{(n_j, n_j)}, b \int_{[0,D]} v(w') dF_{(n_j, n_j)} \right\}$$

in which case the reservation wage is given by:

$$\bar{w}(j) = \frac{b}{1 - b(1 - \theta)} \int_{[\bar{w}(j), D]} (w - \bar{w}(j)) dF_{(n_j, n_j)} \quad (6)$$

where consistently with the hypothesis made above:

$$n_j = \begin{cases} 1, & 0 \leq j < \bar{j} \\ \infty, & \bar{j} \leq j \leq 1 \end{cases} \quad (7)$$

The reservation wage divides $[0, D]$ into two regions: $[0, D] = [0, \bar{w}) \cup [\bar{w}, D]$. Denote by N the acceptance region $[\bar{w}, D]$.

2.3 The Stationary Distribution and the Long-Run Real Average Wage

Make λ_t in $([0, D], \mathcal{B}_{[0,D]})$, represent the measure of the wage offers received by a certain worker at time t . This measure is determined by $P : [0, D] \times \mathcal{B}_D \rightarrow [0, 1]$, the transition function of the problem, as shown below by (8) and (9).

The transition function P is determined in the following way. For elements of the (induced) sample space w in $[0, \bar{w})$, assign a probability measure for sets B in $\mathcal{B}_{[0,D]}$ equal to $q(B)$. Otherwise, for w in $[\bar{w}, D]$, assign, measure 0, θ , $1 - \theta$ or 1 to any B in $\mathcal{B}_{[0,D]}$, depending, respectively, if neither $\{0\}$ or w is in B , if $w \notin B$ but $0 \in B$, if $w \in B$ but $0 \notin B$ or if both $w \in B$ and $0 \in B$.

In order to talk about an invariant distribution of wages in this economy, it is necessary to show that the distribution of wage offers has one and only one fixed point under the operator T^* defined by:

$$m_{o(t+1)}(B) = \int P(w, B) m_{ot}(dw) \quad (8)$$

$$T^*(m_{o(t)})(B) = m_{o(t+1)}(B), B \in \mathcal{B}_{[0,D]} \quad (9)$$

Cysne (2004) provides this demonstration for a more general model.

The next step is finding the invariant distribution λ , which happens to be the fixed point of T^* in the space of probability measures in $([0, D], \mathcal{B}_{[0,D]})$. As shown in Stokey and Lucas (1989, c. 10), for sets $C \subset N$ (of employed workers) this invariant measure is given by the solution to:

$$\lambda_{t+1}(C) = \lambda_t(N^c)q(C) + \lambda_t(C)(1 - \theta) \quad (10)$$

where:

$$\lambda_{t+1}(N^c) = \lambda_t(N^c)q(N^c) + \lambda_t(N)\theta \quad (11a)$$

Taking limits in (11a) and (10) yields, for any $C \subset N$:

$$\lambda(C) = \frac{q(C)}{\theta + q(N)}$$

Since all mass of wage offers in N^c implies a wage equal to zero, the long-run average wage of a certain worker j (which coincides with a cross-sectional average of wages along the whole economy) is then given by:

$$A(j) = \int_{[\bar{w}(j), D]} w d\lambda = \int_{[\bar{w}(j), D]} \frac{w dq_{(n_j, n_j)}}{\theta + q_{(n_j, n_j)}(N(j))} \quad (12)$$

where $\bar{w}(j)$ follows from (6) and the measure q has as distribution function $F_{(n_j, n_j)}$, with n_j being given by (7).

2.4 Income Distribution

The existence of different numbers of draws from the distribution of wages among workers leads to different income patterns. To measure income inequality I use the Gini coefficient of income distribution. The Gini coefficient (G) is a ratio between two areas. The first area is the one between the the curves $f(j) = j$ and the Lorenz curve $L(j)$, to be defined below. The second area is the one between the curves $f(j) = j$ and $g(j) = 0$. In all cases, j runs from 0 to 1. By integrating:

$$G = 1 - 2 \int_{[0,1]} L(j) dj \quad (13)$$

where:

$$L(j) = \frac{1}{\int_0^1 A(u) du} \int_0^j A(u) dm(u) \quad (14)$$

m denoting the measure in the measurable space $([0, 1], \mathcal{B}_{[0,1]})$ determined by (7) and (12). The formula above uses the fact that the long-run average wage A is an increasing function of j .

3 Main Result

Consider two different economies, say, L and H , with different rates of inflation, π_L and π_H (L for "low" and H for "High"). The only difference between economy L and economy H , provoked by the rate of inflation, is that the dispersion of the wage offers in economy H , to be defined precisely below, is greater than in economy L . Other than that, the economies are the same. In each economy, a fraction \bar{j} of the consumers (which I have called group P in section 2) has access to only one wage offer, whereas the remaining fraction, $1 - \bar{j}$, (group R) can have as many draws from the distribution of wages as they desire. Other than that, consumers in each group, and in each economy, are the same.

The exogenous distribution of wage offers is given in each period, respectively, in economies L and H , by the arbitrary measures q_L , with support in $[a_L, b_L]$ and q_H , with support in $[a_H, b_H]$. By assumption, due to the higher rate of inflation in economy H :

$$0 < a_H < a_L < b_L < b_H$$

and

$$\frac{b_L}{E_{q_L} w} < \frac{b_H}{E_{q_H} w} \quad (15)$$

where $E_{q_L} w$ and $E_{q_H} w$ stand for the expected value of the distribution of wages in each economy, respectively, under the measures q_L and q_H . The main result of the paper is given by Proposition 1 below. To simplify the calculations I work under the assumption that the parameters of the model satisfy, in both economies:

$$\begin{aligned} \frac{\beta}{1 + \beta\theta} E_{q_H} w &< a_H \\ \frac{\beta}{1 + \beta\theta} E_{q_L} w &< a_L \end{aligned} \quad (16)$$

Proposition 1 *Consider two economies as described above. Then, the Gini coefficient of income distribution in the economy with high inflation is higher than the one in the economy with low inflation.*

Proof. Consider, first, group R . In each economy, following (6), making $n_j \rightarrow \infty$ in both cases, the reservation wages of workers of group R , in economies, L and H converge in measure, respectively, to $\bar{w}_{LR} = b_L$ and $\bar{w}_{HR} = b_H$, and the average wages (using (12)) to $A_{LR} = \frac{b_L}{1+\theta}$ and $A_{HR} = \frac{b_H}{1+\theta}$.

Now consider group P . Following (6) and (16), their reservation wage is given, respectively, in economy L and H , by $\bar{w}_{LP} = \frac{\beta}{1+\beta\theta} E_{q_L} w$ and $\bar{w}_{HP} =$

$\frac{\beta}{1+\beta\theta}E_{q_H}w$ and (by (12) and (16)) the average wage by $A_{LP} = \frac{E_{q_L}w}{1+\theta}$ and $A_{HR} = \frac{E_{q_H}w}{1+\theta}$.

Next, consider the Gini coefficient of income distribution, initially in economy L . Using (13) and (14), the Lorenz curve $L(j)$ reads:

$$L(j) = \begin{cases} \frac{jA_{LP}}{\bar{j}A_{LP}+(1-\bar{j})A_{LR}} & 0 \leq j < \bar{j} \\ \frac{\bar{j}A_{LP}+(j-\bar{j})A_{LR}}{\bar{j}A_{LP}+(1-\bar{j})A_{LR}} & \bar{j} \leq j \leq 1 \end{cases}$$

and the Gini coefficient:

$$G_L(Z_L) = 1 - \frac{\bar{j}(2-\bar{j}) + (1-\bar{j})^2 Z}{\bar{j} + (1-\bar{j})Z} \quad (17)$$

where $Z_L = \frac{A_{LR}}{A_{LP}}$. Note that $G'_L(Z_L) > 0$. Therefore, since the \bar{j} is the same for both economies L and H :

$$G_L < G_H \Leftrightarrow \frac{A_{LR}}{A_{LP}} = Z_L < Z_H = \frac{A_{HR}}{A_{HP}} \quad (18)$$

This condition is equivalent to having:

$$\frac{b_L}{E_{q_L}w} < \frac{b_H}{E_{q_H}w}$$

which is guaranteed by (the higher dispersion hypothesis) (15). ■

In Proposition I used the assumption that group R can draw an infinite number of points of the distribution given by q_H , as well as assumption (16). The two examples below show that neither of these assumptions is actually necessary. Example one drops the first assumption, and example 2 drops both assumptions.

It is necessary for the main result of the paper, in general, only assuming that group R has one more draw from the distribution than group P , and that wages are more disperse in the economy where inflation is higher.

Example 1 Here I drop the assumption, used in Proposition 1, that the number of wage offers in group R goes to infinity. Assume that q_L and q_H have support in just two points each, q_L in $\{a_L, b_L\}$ and q_H in $\{a_H, b_H\}$, with $0 < a_H < a_L < b_L < b_H \leq D$. Masses (by assumption, all strictly positive) in these points are denoted, respectively, by $q_H(a_H) = q_L(a_L) = q_a$ and $q_L(b_L) = q_H(b_H) = q_b$. Suppose the transformation from L to H is mean preserving, meaning that $q_a a_L + q_b b_L = q_a a_H + q_b b_H$.

In economy L the rate of inflation is π_L and, in economy H , π_H , with $\pi_L < \pi_H$. In each economy, in each period, consumers in $[0, \bar{j})$, when unemployed, have one draw from the distribution of wages (given, respectively, by the measures q_L and q_H), whereas consumers in $[\bar{j}, 1]$ have two draws from the distribution of wages. Other than that, the economies and the respective groups are the same.

Take economy L . In this economy, workers draw wages a_L and b_L with masses q_a and q_b , respectively. First note that if the distribution were degenerated ($a_L = b_L$), then there would be no distinction, in economy L , between those who make one draw and those who make two draws from the distribution of wages. Indeed, in this case the marginal amount of information provided by the second draw is null. In this economy the Gini coefficient of income distribution would be zero, since all workers would have the same average income. It is trivial, though, that the Gini coefficient in economy R , which by assumption would be characterized by a nondegenerated distribution of wage offers, would be greater than the Gini of economy L .

Now suppose, more interestingly, that $a_L \neq b_L$. Still regarding only economy L , the expected values of the distribution of wages, for groups P and R , are given, respectively, by:

$$E_P w = \int_{\{a_L, b_L\}} w dq_{L(1,1)} \quad (19)$$

and

$$E_R w = \int_{\{a_L, b_L\}} w dq_{L(2,2)} \quad (20)$$

Note that $E_P w \leq E_R w$. In a variation of assumption (16), I assume here that the parameters b and θ are such that:

$$\frac{b E_R w}{1 + b\theta} < a_L$$

(an equivalent hypothesis also applying to economy H). This is a necessary and sufficient condition for the reservation wage of both groups, P and R , in each economy, to be below the lower bound a .

The reservation wages in economy L of groups P and R are given, respectively, by $\bar{w}_{LP} = \frac{b}{1+b\theta} E_{LP} w$ and $\bar{w}_{LR} = \frac{b}{1+b\theta} E_{LR} w$, with $\bar{w}_{LP} \leq \bar{w}_{LR}$ (the reservation wage of workers in group R is higher because workers in this group can always simply disregard one of the two draws). From (12):

$$A_{LP} = \frac{E_P w}{1 + \theta} < \frac{E_R w}{1 + \theta} = A_{LR} \quad (21)$$

Using (14) and (13), the Gini coefficient of income distribution (still in economy L), as above, is given by (17). Also as in the demonstration of Proposition 1:

$$G_L < G_H \Leftrightarrow \frac{A_{LR}}{A_{LP}} = Z_L < Z_H = \frac{A_{HR}}{A_{HP}}$$

From (21), dividing both the numerator and the denominator by a_L :

$$\frac{A_{LR}}{A_{LP}} = \frac{q_1^2 + \frac{b_L}{a_L}(1 - q_1^2)}{q_1 + \frac{b_L}{a_L}(1 - q_1)}$$

Since $\frac{A_{LR}}{A_{LP}}$ is an increasing function of $\frac{b_L}{a_L}$, the relative range of the distribution of wage offers in the country with low inflation, and since (15) in this case implies $\frac{b_L}{a_L} < \frac{b_H}{a_H}$, it follows that $\frac{A_{LR}}{A_{LP}} < \frac{A_{HR}}{A_{HP}}$ and that $G_L < G_H$.

Example 2 Regarding Proposition 1, in this second example I drop the assumption that n tends to infinity (here, $n = 2$), as well as assumption (16). Assume that q_L and q_H are given, respectively, by the uniform distribution in $[2, 3]$ and $[1, 4]$. In the respective supports, this leads to the distribution functions $F_{L(1,1)}(s) = -2 + s$, $F_{H(1,1)}(s) = -1/4 + (1/4)s$, $F_{L(2,2)}(s) = 4 - 4s + s^2$, $F_{H(2,2)}(s) = 1/16 - (1/8)s + (1/16)s^2$. Using (6), and (12), after some tedious calculations, the reservation wages and the average wages, in each case, can be shown to assume the values given by Table 1 below:

Table 1				
		Economy		Ratio H/L
		Low	High	
Res. Wage	Worker	Rich	2.71 3.44	1.27
		Poor	2.61 3.25	1.24
Aver. Wage	Worker	Rich	2.81 3.64	1.037
		Poor	2.75 3.51	1.024

The most important point in Table 1 is that the ratio of the average wages, between economy H and economy L , is higher for the rich than for the poor. By (18), this implies that income is more concentrated in economy H than in economy L . The reason for $\frac{A_{LR}}{A_{LP}} < \frac{A_{HR}}{A_{HP}}$, as presented in the demonstration of Proposition 1, is that the rich are more able to take advantage of the (mean-preserving) increase of uncertainty than the poor.

It is also interesting to note that (as one would expect) the rich always have a higher reservation wage and a higher average wage than the poor, in both economies, L and H .

And that, for both groups, R and L , the reservation wage and the average wage in economy H is higher than in economy L . This fact shows that both groups are able to take advantage of the increase of uncertainty, because of the option-nature of the job-search mechanism (bad draws can always be discarded).

4 Conclusion

In this paper I formalize a link between inflation and the Gini coefficient of income inequality, assuming that higher rates of inflation lead to an increase of the dispersion of wage offers. Under this setting, the higher the inflation rate, the higher turns out to be the benefit, for a worker, of making additional draws from the distribution of wages. Assuming that some workers have less access to information (wage offers) than others, I show that the Gini coefficient of income distribution turns out to be an increasing function of the rate of inflation. Two examples are provided to illustrate the mechanism.

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